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Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 157

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SOVIETS AGREE TO LIMIT FINNISH NUCLEAR PLANT TO 1,000 MW

Helsinki HELSINGIN SANOMAT in Finnish 16 Jun 82 p 27

[Article: "Only Large Power Plant Discussed Between Finland and Soviet Union"]

[Text] Economic Adviser M. V. Titov of the Soviet Embassy in Helsinki emphasizes that the feasibility study agreement between Imatra Power and Atomenergoeksport concerns only a 1,000-megawatt nuclear power plant.

According to Titov the possibility that the feasibility of two 500-megawatt power plants would be studied is a matter which has been discussed primarily only in the Finnish press.

Counselor of Mining Pentti Alajoki proposed publicly some time ago the possibility that instead of a 1,000-megawatt nuclear power plant the construction of two 500-megawatt units could be considered with respect to the next power plant project.

From a technical point of view the construction of a 500-megawatt power plant would not, however, present any particular problems according to Soviet experts. The reactors in the present 460-megawatt plants at Loviisa are capable of developing a 500-megawatt capacity, but the turbines have been designed for a smaller output.

The nuclear power plant was uppermost as an unofficial issue at a press conference in Helsinki on Tuesday in the office of the economic affairs section of the Soviet Embassy in connection with the 25th anniversary of the establishment of the Soviet State Committee for Foreign Economic Relations.

The state committee and its subordinate organizations have relations with more than 80 countries. There are 4,000 projects under its jurisdiction, of which more than 2,600 are in operation.

Cooperation on Development

There is room for development in cooperation between Finland and the Soviet Union since according to Titov the Finns are not taking full advantage of all those opportunities which cooperation can offer them in the chemical industry, the machine building industry, and the foodstuffs industry.

He emphasized that Soviet enterprises also have considerable experience in projects connected with transportation and environmental protection.

The Soviets are also ready to participate in projects of a smaller scale such as the nuclear power plant at Loviisa, Rautaruukki, the power plant at Tahkoluoto, and the gas pipeline.

As an example of smaller joint projects Titov mentioned the purfication plant in Kemi. "This type of cooperation will create a good foundation for continuing a similar type of cooperation in third-party countries also. Cooperation between V/O Tyazhpromeksport [All-Union Association for Heavy Industry Exports], Rautaruukki, and Perusyhtyma is a good example of this."

10576
CSO: 5100/2190

KWU COMMENTS ON SALE OF U.S. COMPUTER TO ARGENTINA

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 22 Jul 82 p 31

[Text] The spokesman for KWU--Kraftwerk Union--Wolfgang Breyer, said yesterday that the sale of a computer system by the United States for the heavy water powerplant being built by the Swiss company, Sulzer Brothers Limited, in Argentina does not mean the abandonment of the policy of restrictions on countries which did not sign the nonproliferation treaty. As in Brazil, the KWU is also the main foreign company involved in the nuclear program in Argentina.

According to Breyer, the computer system exists on the international market and could have been obtained from other countries without any mystery whatever. He explained that the heavy water powerplant is only a chemical plant, not a nuclear plant, because it causes no radiation nor does it handle radioactive elements, although it is fundamentally for the type of nuclear program chosen by Argentina, which uses heavy water and natural uranium reactors.

Breyer explained that heavy water is necessary for use as a reactor moderator (moderating the process of chain fission) and that all the countries which produce atomic bombs do so with military reactors which produce plutonium and are moderated by heavy water, except England and France, which obtain plutonium for military purposes in gas reactors moderated by graphite. Heavy water is one of the methods, but not the only one, for obtaining the atomic bomb, according to Breyer.

Inspection

The KWU engineer declared that there is confusion in the news and that the fact that it sold the computer system does not mean the United States is going to change its policy of forbidding the transfer of sensitive technology to countries, which like Brazil and Argentina, are developing their own nuclear programs. In Breyer's opinion, the Argentine Government is the one who controls its nuclear program, not the United States, and since the heavy water powerplant is under safeguards, like the entire Argentine nuclear program, the International Agency of Vienna [IAEA] can make an inspection if it so desires.

Therefore, the German engineer sees no reason why the North Americans should not sell its computers, which can be bought in France, Japan, Sweden, Germany and other countries, without any great problem. Breyer also declared that there was no cancellation of the Argentine nuclear program because of the support Germany gave to England in the Falkland conflict. He explained that the president of the National Atomic Energy Commission [CNEA] of Argentina, Vice Adm Castro Madero, was recently in Germany and guaranteed that the agreement between the two countries would be fulfilled regardless of the Falklands episode, but with a delay of 1 year due to the lack of resources Argentina is undergoing.

Because of that delay, he said the Atucha II nuclear powerplant, which is under construction, will not be inaugurated in 1987 but in 1988. Because of that, Argentina will have another year to decide on the construction of the other three powerplants of a total of four scheduled by the year 2000. Breyer also said that the fuel element plant of Ezeiza is ready and in operating condition.

Brazil-Argentina

On 17 May 1980, a protocol of understanding was signed between Minister Carlos Washington Pastor and Ramiro Sariava Guerreiro, pursuant to which Brazil and Argentina would begin to engage in technical and commercial collaboration and in the technological development of the nuclear sector. That was practically the beginning of a pact between the two countries for resisting North American pressures against the installation of a nuclear industry sought by Argentina and Brazil.

In the commercial field, this pact has already borne fruit, with NUCLEP--NUCLEBRAS [Brazilian Nuclear Corporation] Heavy Equipment--responsible for the lower part of the pressure vessel for the Atucha II reactor, while the CNEA will supply the zircalloy covered pipes to be used as rods in the Brazilian reactors. Argentina will also provide Brazil with 240 tons of uranium concentrate when the fuel element plant at Resende is in operation.

8908
CSO: 5100/2224

MILITARY SOURCES SAY DEVELOPMENT OF NUCLEAR WEAPONS INEVITABLE

Brasilia CORREIO BRAZILIENSE in Portuguese 14 Jul 82 p 3

[Text] "Brazil is working on the development of its research, always with a view toward technological independence, which in the future may lead to the initial project of the atomic bomb, but as a natural consequence. That does not mean, however, that we are working to arrive at that project." It is a matter of scientific and peaceful research. This is the opinion of several military persons questioned yesterday in Brasilia, who firmly advocated the need for having our own means for research in addition to affirming that Brazil should have the right to learn atomic technology.

Those same sources explained, however, that if Brazil were interested in acquiring the technology or redoubling its efforts for manufacturing the atomic bomb, it would have initiated its research many years ago in the example of Argentina. However, they emphasize, "It is obvious that we cannot remain behind with respect to the other countries of the world. We also need research in the nuclear area because it is very important for the future of countries. The navy itself needs to use nuclear energy for the propulsion of submarines."

Researching uranium in its natural form, say the military persons, "We shall inevitably arrive at nuclear weapons. It is only a question of time. Argentina has developed its nuclear policy through its local technology. That should be the path taken by all countries."

"Even with the Malvinas War, which must have delayed and even upset the nuclear program of that country, we today are not in a condition to compete with Argentina in that area, since they have been working on that project since the decade of the 50's, regardless of the politics of that country." We, added the military persons, are only beginning atomic research, but even with purely peaceful intentions, studying the various reactions of uranium, we shall get there.

8908
CSO: 5100/2224

CTA OFFICIAL: NUCLEAR RESEARCH HAS NO MILITARY OBJECTIVE

Rio de Janeiro JORNAL DO BRASIL in Portuguese 9 Jul 82 p 20

[Text] Sao Paulo--"We are in no position to reach the point you imagine we are going to reach." That is the opinion of Air Force Gen Lauro Ney Menezes, general director of the Aerospace Technology Center [CTA], concerning the possibility that Brazil will develop a military nuclear device on the basis of programs developed by scientists at the Institute for Advanced Studies [IEA], one of the seven research organizations operated by that unit of the Ministry of Air in Sao Jose dos Campos.

The general explained that the construction of fast nuclear reactors--one of the IEA's priorities--will insure the country of maximum efficiency in utilizing the existing reserves of thorium and uranium, but that "only a critical analysis of the technical aspects, weighed against the political, economic, and strategic implications, will dictate the type of reactor most suited to Brazilian reality."

Strategy

The IEA was established because of the need to conduct research on the frontier of human knowledge, "because no one transfers or sells strategic technology," General Menezes emphasized. He recalls that the institute's purpose is to supplement the necessary support for projects developed by the CTA's other institutes "by conducting research in pure and applied science to meet the needs of important programs of national interest."

According to him, the IEA's four priority research programs are concerned specifically with development of the laser, construction of an electron linear accelerator, construction of a fast nuclear reactor, and laser enrichment. The CTA's director stressed that none of those programs has a military objective: their only purpose is to provide technological capability.

He commented: "That would not prevent the research from leading to military byproducts, such as the rangefinder designed on the basis of laser studies," and he pointed out that in such a case, it would be a matter of "serendipity"--an English word meaning "the gift of making felicitous and unexpected discoveries."

Air Force General Lauro
leads the CTA

Colonel Amorim does
research at the IPEN

Maj Menezes emphasized that "to the extent that we advance toward the frontier of human knowledge and increase our technological capability, we will be freeing ourselves of the conditions set by the external market and bringing decisionmaking power to the national territory, thereby taking charge of a share of our progress and extending our sovereignty."

No Secrets

According to General Menezes, none of the IEA's programs is secret, and they will all take a long time to mature, "since the actual intention is to establish a group with high technological capability made up of civilian and military scientists."

He revealed that the IEA maintains a program of exchange with the Brazilian Center for Physics Research, the Physics Institute of Sao Paulo University, and the Physics Institute of Campinas State University, as well as being in close contact with institutes abroad such as the Max Planck Institute in the FRG. Currently, the institute is concluding arrangements for new scientific cooperation with Sao Paulo University and the California Institute of Technology in the area of atomic and molecular physics as part of the bilateral cooperation existing between Brazil's National Council for Scientific and Technological Development and the National Science Foundation of the United States.

Energy

As for the program aimed at producing a fast nuclear reactor, General Menezes explained that that project involves an assessment of the cycle and the choice of the technology for fast breeder reactors that is most suited to Brazilian reality.

He emphasized that the construction and testing of a low-powered experimental unit is aimed at providing the country with "maximum efficiency in utilizing the existing reserves of thorium and uranium." According to official estimates, those reserves amount to about 215,000 tons of uranium and 1.27 million tons of thorium oxide. Those reserves would enable Brazil to produce electricity for 1,300 years with uranium and for 7,800 years with thorium, including in that calculation all the electric power produced by the country's total hydroelectric potential.

Another IEA priority in the nuclear area is to develop a 180-million-volt electron linear accelerator. That accelerator will be used for research and the acquisition of technological know-how in the nuclear area. The project is staggered in such a way that it will begin with construction of a 17-million-volt accelerator in cooperation with the USP [Sao Paulo University] Physics Institute. This will be followed by construction of a basic unit for the accelerator that will eventually produce 180 million volts.

IPEN Investigating Reactor Material

Sao Paulo--The Nuclear and Energy Research Institute (IPEN) of Sao Paulo, an organization connected with the National Energy Commission and NUCLEBRAS [Brazilian Nuclear Corporations], has been engaged over the past 5 years in a series of research projects commissioned by the Aerospace Technology Center and concerned with various materials and fuels that will be used in Brazilian atomic reactors.

The contract, which has not been publicized during those years, is concerned with research intended chiefly for use by the CTA's Materials Department. At the IPEN, the work is done at the chemical engineering and nuclear metallurgy centers and is concerned with the applications of uranium, thorium and zirconium. The results are sent directly from Sao Paulo to Sao Jose dos Campos by computer hookup. There the information is received and stored by computer.

Research

In that nuclear research, the CTA processes information received from the IPEN and also from UNICAMP [Campinas State University]. The work is condensed and coordinated by the Institute for Advanced Studies, which was established precisely for that purpose on land belonging to the CTA. It was there that the Air Force initially developed a zirconium alloy (a material with which uranium is significantly associated) for use in manufacturing airplanes.

In the second phase, however, direct research with nuclear fuels began. The superintendent of the IPEN, Hernani Augusto Amorim, explained that the study center supplies the CTA with research concerning the nature of impurities in nuclear materials. For that purpose, it uses high-resolution gamma-ray spectrometry, X-rays, mass spectrometry, and electrochemical methods. In addition, it employs electronic microprobes and conducts general tests, including tests for surface corrosion on a microscopic scale.

Amorim explains: "It all began when the CTA looked us up because we had the technicians and equipment it needed for its research with zirconium. For example, we have a microscope that is the only one of its kind in the country. Then there began to be more than enough zirconium uranium, and the research became diversified. Today the CTA is also trying to obtain uranium from another ore: caldasite, which is abundant in Pocos de Caldas."

Zirconium is also used to manufacture the rods containing the fuel that is placed in the reactors. Another atomic element also being researched by the CTA--thorium--cannot be used to fuel the thermal reactors that Brazil will build, but it can be used in the fast reactors, whose technology is also reportedly being studied in Sao Jose dos Campos for military purposes. Amorim admitted: "That item must be included in the so-called classified (secret) work that the IPEN also does for the CTA."

Concerning the IPEN's participation in furnishing support material for the CTA's research with fast reactors, Amorim said he did not know what the work his institute provides is used for. He explained. "We operate as a laboratory that simply fills prescriptions."

Underground Laboratories

Sao Paulo--The IFA is located under the lawn at the CTA in Sao Jose dos Campos along the road linking the Dutra Highway to the state's northern coast. In addition to those hexagon-shaped underground facilities, six buildings are being prepared for occupation by 1,200 employees, including 500 scientists who will work on the fast reactor and laser enrichment unit projects in addition to doing other research.

About 200 employees already work in the underground laboratories. Their number includes specialists who have taken postgraduate courses in the FRG, France, Great Britain, and the United States. Only personnel authorized by the CTA are allowed to enter the facility. The IEA complex will not be completed until 1985.

Installed in the underground facility a few years ago and still in full operation is a computer of the latest generation with large storage capacity. It is the Data Cyber 170/750, manufactured by the Control Data Corporation of the

United States. It is programmed to accept about 15 million instructions per second and to process the technical and scientific data needed for the research done at the center. It also provides nuclear and aerospace technological solutions. Its terminals are linked to UNICAMP, the IPEN, and the National Nuclear Energy Commission in Rio de Janeiro.

IEA Working With Lasers

Sao Paulo--The origin of the Aerospace Technology Center's Institute for Advanced Studies (IEA) was a contract signed in 1973 with the Campinas State University (UNICAMP) to conduct research into the separation of uranium isotopes using laser beams.

UNICAMP's laser group was able to develop isotope separation and the production of heavy water in theory, but once research passed to a less theoretical and more practical stage, it became the province of the CTA (which established the Laboratory for Advanced Studies, later transformed into the IEA) and the Nuclear and Energy Research Institute (IPEN) in Sao Paulo.

Old Idea

Rogerio Cerqueira Leite, director of UNICAMP's Gleb Wataghin Physics Institute, recalled yesterday that Sergio Porto, the Rio de Janeiro physicist, first mentioned the idea of separating isotopes with laser beams to him in 1965, when both of them were working in the United States.

In 1972, on being invited to return to Brazil by Zeferino Vaz, the founder of UNICAMP, Sergio Porto remembered his old idea. With support from Vaz and Cerqueira Leite, Porto signed an agreement with the CTA in 1973 to conduct basic research on isotope separation using lasers. The research was actually financed by the National Nuclear Energy Commission (CNEN), with the CTA and the IPEN acting merely as intermediaries.

Cerqueira Leite said: "Sergio's idea was simple. He only wanted to excite the molecules with atoms of uranium-235 for enrichment. He did not do it, however, with heavy materials, but with light materials such as hydrogen and boron. When the research reached the practical stage, it was transferred permanently to the IPEN and the CTA."

Enrichment

Uranium-235 is fissionable and can be used as is to fuel an electric power plant or a bomb (although physicist Cerqueira Leite regards an atom bomb using enriched uranium as outdated and expensive--a bomb can be produced more easily with plutonium and hydrogen). It happens, however, that it occures in nature at a rate of only 0.7 percent--that is, there is 1 atom of fissionable uranium-235 for every 140 atoms of uranium-238 (natural uranium, which is not as easily fissionable).

Since the masses of uranium-235 and uranium-238 are practically I7-8', it is nearly impossible to separate--or, more accurately, enrich--the uranium and make it fissionable (that is, a fuel) by physical means. Sergio Porto's idea was to bombard the uranium with a laser, thus transferring the beam's energy to the molecule. Since uranium-235 is fissionable, it becomes more excited and can then be separated--or, more accurately, enriched.

The principle is the same for producing heavy water (the moderator in a natural-uranium reactor). Heavy water is ordinary water with a heavier hydrogen atom (one more proton). That abnormality can also be produced by "excitation" induced by a laser beam.

In 1979, when Prof. Sergio Porto died of a heart attack in the Soviet Union, the group engaged in isotope separation by laser was already deactivating its theoretical research and transferring it to the CTA and the IPEN.

11798
CSO: 1100/2215

SBPC SEEKS INFORMATION ON MILITARY RESEARCH; REACTION

SBPC Seeks Information

Rio de Janeiro JORNAL DO BRASIL in Portuguese 9 Jul 82 p 6

[Article by Jose Neumanne Pinto]

[Excerpt] Sao Paulo--Brazilian scientists are not criticizing the military institutions for developing applied research programs. They are simply afraid that funds for their own research will be cut as a result of those programs, and they are asking that society be informed not about the content of such research, which is obviously secret, but about its existence.

"We do not want to know what is happening behind the walls of the Institute for Advanced Studies (IEA) at the Aerospace Technology Center (CTA) in Sao Jose dos Campos. We simply feel that society should be informed that such a laboratory exists and that it is engaged in secret research," explained physicist Rogerio Cerqueira Leite, who is going to coordinate the SBPC [Brazilian Society for the Advancement of Sciences]-Brazilian Physics Society symposium on the "Allocation of Funds to Research for Military Applications" that will be held at 1500 hours on Monday as part of the 34th SBPC Annual Meeting in Campinas.

Concern

Physicist Jose Antonio de Freitas Pacheco of the National Observatory had drawn attention to the existence of the CTA's IEA during the 33rd SBPC Annual Meeting, which was held last year in Salvador. Because of his having sounded the alert, the Brazilian Physics Society considered it advisable to take advantage of the 34th SBPC Annual Meeting in Campinas to present specific data on the diversion to military research of funds normally allocated to scientific research.

Freitas Pacheco will speak on Monday morning concerning "The Development of Space Science in Brazil," and Prof Sergio Machado Rezende of the Pernambuco Federal University will speak on "Research in the Area of Electronics and Data Processing."

Rogerio Cerqueira Leite, director of the Gleb Wattaghin Physics Institute at Campinas State University (UNICAMP) will speak on "The World Situation in Arms-Related Research."

Cerqueira Leite said: "I personally don't have the data, but we all suspect that money for basic research is being diverted to military research. Up to this point, the scientific community's attitude has not been one of antagonism, but of alertness. We want to avoid a repetition here of the errors committed earlier in the United States."

According to him, it is not evident when FINEP [Funding Authority for Studies and Projects] is giving money to the military area or to research commissioned from nonmilitary institutions for military purposes.

IEA Denies Nuclear Bomb Intentions

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 9 Jul 82 p 14

[Text] In its nuclear programs, the objective of the Institute for Advanced Studies at the Aerospace Technology Center is "simply to create national capability in that area, with no military objectives in view." This according to a statement yesterday by a highly placed source close to the CTA's management in Sao Jose dos Campos, who was responding to accusations by scientists attending the SBPC meeting in Campinas that a secret program existed for building atom bombs.

The same source said ironically: "That would be great, because it would mean that we have a lot of money. But the truth is something else. The funds are far below the levels that Brazilian society would like to be able to maintain."

According to the official at the center, the IEA's isolation is necessary to its purpose as a research unit for pure science: "a real lineup of brains." However, if one of those specialists "comes up with results in that area (meaning military applications), rest assured that he will keep working." The same official emphasized, however, that "the way the institute's programs are structured today, there is no way to come up with a bomb."

The CTA's approach is to obtain military byproducts from civilian projects, not the other way around, which is the way it happened, for example, in the case of the laser rangefinder for artillery sighting systems. In the field of ordnance, the CTA's priority is the infrared air-to-air Piranha missile, a project that has been frozen for 2 years and will be restarted in 1983 "or even earlier, depending on the availability of funds," and the project for the AM-X aircraft, an attack and interdiction jet aircraft which Brazil is going to build in cooperation with Italy. The timetable for that undertaking has been speeded up by mutual agreement between the air forces of both countries, with the result that the first operational plane will be commissioned by the Brazilian Air Force in 1986.

11798
CSO: 5100/2215

BRAZIL

POLITICAL PARTIES POLLED ON NUCLEAR BOMB RESEARCH

Sao Paulo FOLHA DE SAO PAULO in Portuguese 17 Jul 82 p 4

[Text] Giving continuity to the study of subjects of local and national interest proposed by FOLHA, the political parties today express their opinions--through representatives selected by the respective regional leaderships--with respect to the following question: "Should Brazil engage in research for the production of A bombs?"

The writers are: Gastone Righi for the PTB [Brazilian Labor Party], Euzebio Rocha for the PDT [Democratic Workers Party], Luis Carlos Menezes for the PT [Workers Party], Flavio Bierrenbach for the PMDB [Brazilian Democratic Movement Party] and Elias Assis Filho for the PDS [Social Democratic Party].

Tomorrow the political groups will make an analysis of their activities in response to the following questions: "What errors has your party committed?"

PTB "We must remain a peaceful nation." (Gastone Righi)

Since antiquity, war, as one of the beasts of the apocalypse, has been one of the most frightful scourges of humanity.

In modern time, when weapons of individual destruction were replaced by atomic power, which decimates entire populations and places in jeopardy the very survival of the planet, it becomes a permanent threat we all repudiate. However, it is not the possibility of the construction of armaments we must fear but their actual construction and use for warlike and destructive purposes.

The more civilization advances scientifically and technologically, new weapons and forces of destruction and disintegration will inevitably be discovered and developed. New scientific experiments for peaceful purposes, primarily in the energy field, automatically result in military advantages.

The same dynamite, which as a bomb destroyed human lives, serves for blowing up mountains for the construction of dikes and dams. The same equipment which propels a missile, propels a rocket for space research or modern forms of aircraft which carry people and merchandise. The same nuclear energy, which can raze cities, powers electric powerplants, ships and submarines, and its technology produces radioisotopes for medical and industrial purposes.

Through research in nuclear fission in the process of atomic disintegration, new discoveries, as well as the most modern and sophisticated technology, may be acquired, benefitting humanity, particularly Brazil which is rich in radioactive minerals and without the technological resources for using them.

We are, and we must remain, a peaceful nation. However, we cannot remain an underdeveloped country dependent on more advanced countries. We must catch them and pass them if possible. In the present, and much more so in the future, this will be conditioned by the scientific and technological domination acquired. For this, it is necessary to do research, not on the atomic bomb, but on nuclear energy, even if the dominion of this science will make possible the production of that dreadful weapon.

PDT "Let us discard the priorities of that research" (Euzebio Rocha)

To govern means the establishment of priorities, defining of objectives and planning of activities. However, it is up to political power to orient options. The grandiose and disastrous nuclear program clearly reveals a plutocratic government at the service of the oligarchies, ignoring the interests of the national community. Let us discard the priority agreement that Brazil effect research for the production of the atomic bomb. It is not possible to think that nuclear technology means the production of the A bomb or electricity. Eminent scientist Marcelo Damy has already said: "To confound nuclear activity with production of electricity is the same thing as thinking that electricity means the electric chair."

To have a perfunctory idea of the importance of nuclear technology, it is enough to note the broad field it covers: radioisotopic technology, agricultural applications, gammagraphy, sea water desalinization reactors and nuclear explosions for peaceful purposes.

In all the items cited, nuclear technology is characterized by precision in the solution of problems and economy in costs. Thus, a task of civil engineering accomplished with nuclear explosives becomes a thousand times cheaper than if it were done by grading. A nation which gives up nuclear technology, will lose international competitiveness.

The social well-being of the nation, economic development, the security of the country are linked to the excellence of its scientific life and the quality of education. The system which governs the country works contrary to those principles. It spends $75 billion on a nuclear program which takes us nowhere.

We could build 375 hospital clinics like that of Sao Paulo or pay the foreign debt with that money. The "jet centrifuge" project is a laboratory technique that has not been proved industrially, which consumes 20 times more energy than the other processes. Angra I delayed its operations 5 years and is operating at only [illegible] percent of its capacity and in an irregular manner. It is the enormousness of a disastrous project which only satisfies the megalomania of incompetent technocrats.

PT "It would be ridiculous for Brazil to develop bombs" (Luis Carlos Menezes)

There are so many and justifiable arguments, based on humanistic principles, against the production and use of nuclear explosives that it could be constraining to enter into the political-strategic merits of the problem. However, even on this plane, it is necessary to combat the "realism" of those who propose construction of such bombs.

The number of nuclear warheads, which could be fired at any moment, available to the great powers is so great, that a small fraction of them is sufficient to partially or totally destroy all the population of the world and make any possible survivors genetically impotent. It would be ridiculous for Brazil to develop some bombs to face this power. The victory of the Vietnamese people against American nuclear power demonstrates that popular resistance is the only means possible for facing world hegemony of any type.

If, on the other hand, there is thought of the bombs for possible conflicts with some Third World country, the stupidity would reside in thinking that a conflict of "nuclear" proportions can take place without the polarization of the great powers and their arsenals, in addition to being in a historically wrong position.

Brazil can undoubtedly become a leader in what is usually called the Third World, particularly when it acquires a democratic system of respect for popular will. The Workers Party hopes that this will be a moral, industrial and agricultural leadership without the perfidy of the powers which proclaim peace but prepare for war.

PMDB "Against any deadly device of the type" (Flavio Bierrenbach)

The PMDB, like the immense majority of Brazilians, is against the use of the atomic bomb and any deadly device of the type. It is unnecessary to argue to defend this point of view. Beginning with the need to defend the ecology and ranging through the undeniable right to life, to the discussion of questions of military strategy, nothing justifies Brazil's engaging in the construction of an atomic bomb. It is not even necessary to argue about the cost of a possible program aimed at the construction of the atomic bomb. Nothing councils such a feat.

In its program, the PMDB advocates the need to increase the scientific-technological capacity of the country. Therefore, it supports nuclear research and the use of technical resources which may result from it for the benefit of the people. However, in order for that to happen, it is necessary to submit the decisions on research to the scientific community and to society.

In this respect, debates such as those of the SBPC [Brazilian Society for the Advancement of Science] on the possible construction of the A bomb, as well as the denials by the government, are necessary to prevent small groups, caparisoned in the trappings of the state, from adopting decisions against the wishes of the nation, which lead to the construction of the bomb, against everything and against everyone.

An example of this type of decision was the one on the construction of the atomic powerplants through the Brazil-Germany agreements, decision made without the knowledge of society and whose calamitous economic and technical results are known by all.

The PMDB in government will be a guarantee that nuclear policy decisions will be made with technical competence and with the approval of society.

PDS "The atom must also be used for military purposes" (Elias Assis Filho)

The atomic bomb is a weapon of aggression, not of defense.

It would be a powerful international tranquilizer if in this time of terrible concerns the discovery of Democritus (the atom) would remain indivisible. Atom means "something which has no volume," something which naturally is not true because it has volume and has weight and is every day more divisible, not only through the discovery of protons, electrons, neutrons and mesons--these were discovered by [illegible] later--but in the future, through the discovery of other elements which make it up.

When Fermi and Oppenheimer achieved the splitting of the atom, already foreseen long before by Rutherford, these two great scientists feared that the destruction of a single atom would result in the imbalance of matter, a chain reaction, which could mean the destruction of the entire world. Truman allowed the explosion of the first two atomic bombs over Japan and there was no chain reaction, as had already been proved in the laboratory.

The world today groans and exhausts itself in fratrecidal wars. Economic interests are primarily responsible for formidable genocides. A disarmed country is easy prey for the unbridled greed of powerful nations, which enslave it, exploit it, making any independence impossible. As far as Brazil is concerned, no! we shall never be the slaves of anyone and we shall always be the masters of our future. Against the declared aggressiveness of powerful nations and groups we should prepare for our defense. As the Romas said: "Si Vis Pacem, para Bellum--if you want peace, prepare for war."

The PDS favors studies for the use of the atom for peaceful purposes also, not as an aggressive means--because we are peaceful--but as a means for defending the country against aggressions, whatever they may be and from wherever they may come.

[illegible]
CSO: 3340/2224

HIGH-TEMPERATURE PLASMA EXPERIMENTS PROGRESSING AT UNICAMP

Sao Paulo FOLHA DE SAO PAULO in Portuguese 10 Jul 82 p 16

[Article by Laerte Ziggiatti: "Thermonuclear Fusion Energy"]

[Text] A project related to the obtention of energy through controlled thermonuclear fusion--which in all probability will become one of the main solutions for the present energy crisis--has been in progress at the Campinas State University (UNICAMP) since 1974.

A great effort is being made in the principal world research centers for making it technically possible to obtain energy on the basis of hydrogen isotopes, which are deuterium and tritium. In other words, the present state of nuclear fusion development is that of demonstrating its scientific viability in the sense that such a process will produce more energy than the energy applied to produce it. In the next state will come the demonstration by engineering of the possibilities of building a nuclear fusion reactor. The third and last phase will be the construction of a technological prototype of the reactor to make the production of energy at a commercial level practical.

According to the coordinator of the project in progress at the UNICAMP Physics Institute, Paulo Hiroshi Sakanaka, the first scientific demonstration stage will surely be completed within 3 to 5 years in research centers of the United States, Japan, Europe and the Soviet Union, the time for the appearance of the commercial prototype being foreseen as 30 to 40 years.

The UNICAMP project--financed with funds of the FINEP [Funding Authority for Studies and Projects], CNPq [National Scientific and Technological Development Council], FAPESP [expansion unknown] and the National Nuclear Energy Commission [CNEN]--is aimed specifically at the study of magnetic confinement of high-temperature plasmas.

As Professor Sakanaka explains, "The study of those plasmas is essential for obtaining light isotope nuclear reaction." The research group he leads is specialized in nontoroidal magnetic confinement such as the system known as the teta-pinch and the magnetic mirror.

There are two devices of the teta-pinch type and two of the second type in operation, performing confinement of high-temperature plasmas in the Physics Institute for obtaining nuclear fusion reaction. Temperatures reached are on the order of 3 million degrees Celsius. According to Sakanaka, the objective during this phase of research is the study of the heating of plasmas by means of magnetic implosion and the creation of stability rings. Also studied, is the halting of the escape of plasma through the ends and the properties of energy and particle transportation. A larger teta-pinch system known as the "Tupa," financed entirely by FINEP, went into operation March this year.

"In that system," says Professor Sakanaka, "we expect to obtain plasma with high temperatures of between 10 to 20 million degrees celcius."

According to him, the CNEN is very interested in the development of that system, having recently initiated a larger financing with the promise of increasing it substantially from here on.

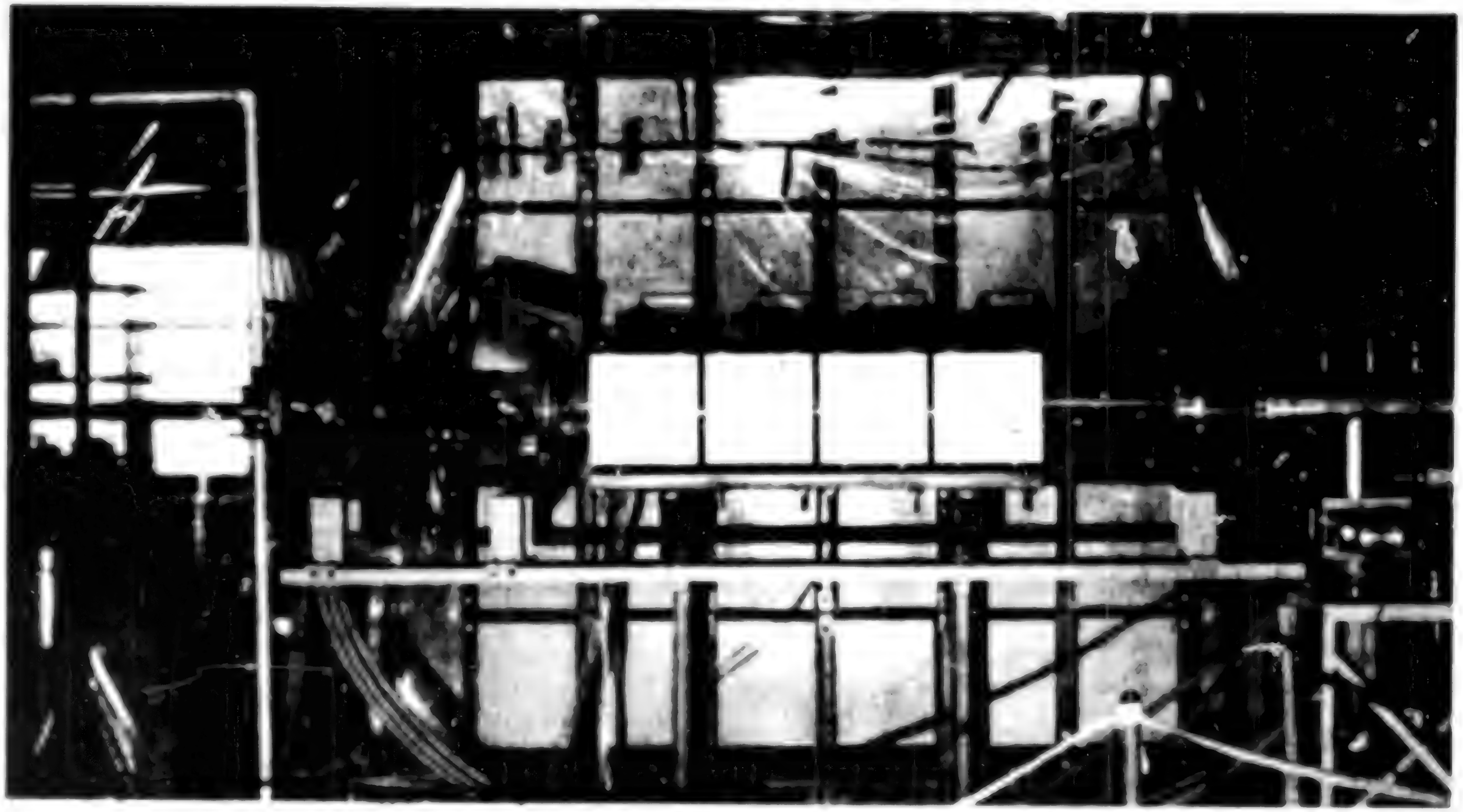
"Brazil is only beginning research in that area and is well behind the levels attained in developed countries," acknowledges Sakanaka. "However," he asserts, the government is very interested in a rapid development in the area," whose still slow pace is basically determined by the shortage of human resources in the country. Says, only six institutions are performing research on plasma for nuclear fusion: the University of Sao Paulo, Federal University of Rio Grande do Sul, the Space Research Institute, the ITA [Technical Aeronautics Institute] and UNICAMP. The main objective of those centers is the training of technical and scientific personnel by means of modest projects, as is the case of the University of Sao Paulo, which is building a small toroidal confinement machine known as the "Tokamak," for learning purposes.

In August 1981, upon the initiative of the Ministry of Mines and Energy and the coordination of the CNEN, a planning commission was created which prepared a national physics program on controlled thermonuclear fusion for the purpose of unifying the up until now scattered research efforts in that area. According to Professor Sakanaka, it makes no sense to dilute resources by having several centers devoted to the same research, it also being an objective of that commission to train a national team on the physics of plasma in thermonuclear fusion. He said that Minister Cesar Cals also intends to send this project of unification to President Joao Baptista Figueiredo this year.

"That center, if created, will certainly intensify research on nuclear fusion among us, however, within the possibilities in human and financial resources of the country," says the UNICAMP physicist.

The Process Does not Release Radioactivity

Professor Paulo Hiroshi Sakanaka asserts the project is not even remotely a result of any other nuclear agreement of the type established between Brazil and Germany, which is the object of criticism, not only because of the large amounts of funds allocated to it, but also because of the danger represented by radioactivity. The fact is that in the latter project, energy is obtained by the fission of heavy atoms such as uranium, producing radioactive isotopes with an average life of 500 years. It is cumulative radioactive pollution, with problems of storage of that "waste", which has not yet been resolved satisfactory. Moreover, says Sakanaka, "There is the theoretical possibility of a nuclear explosion of the plant housing the reactor."



This is the "Tupe," the Teta-Pinch 100 KV system for confinement and heating of plasma by magnetic implosion

He also explains that nuclear fusion comes from the reaction of light atom fusion, such as that of hydrogen atoms (deuterium and tritium) and lithium. That process releases no radioactive product, nor is there the possibility of an explosion, there being, therefore, in the opinion of the scientist, greater safety by comparison with nuclear fission.

Another point of comparison to be emphasized refers to the problem of the fuels required by each process; the greater or lesser degree of difficulty in obtaining the raw materials. In this aspect, nuclear fission depends on uranium, which although abundant "in world terms," is found only in some countries, which brings up questions of monopolies of the mineral with all its consequences. On the other hand, fuels used in the fusion process--hydrogen and lithium--are found almost everywhere.

Professor Sakanaka estimates that world reserves of uranium are enough for 300 years of use, providing, he says, that the fast breeder reactor is developed, and also if all countries are producing energy by means of the nuclear fission process in the near future. In that respect, the energy path using fission with uranium as a fuel, presents a limited horizon. As for fusion, Sakanaka declares: "There is no limit whatsoever."

In terms of energy production, that is, greater or lesser efficiency of a process by comparison with the other, as far as the production of energy is concerned, it is still very difficult to make a comparison, which has to be made, according to the UNICAMP physicist, on the basis of costs for the amount of energy produced. This difficulty weighs more against nuclear fusion because it is a project in the scientific demonstration phase and because no reactor suitable for the process has been developed yet. When that happens, its real costs can be established and, subsequently, there will be bases for establishing comparative advantages.

Generally, Professor Paulo Hiroshi Sakanaka views the project being executed by UNICAMP and other national institutions with great optimism. He even believes that it is almost certain that the process for obtaining energy through controlled thermonuclear fusion could represent a great hope for resolving the world energy problem in the future, particularly, he recalls again, because it does not cause pollution, does not bring the danger of reactor explosion, and finally, because it has as a practically inexhaustible source of fuel. In that respect, he believes "Brazil should intensify research in that sector with much more vigor," particularly because the country also presents one advantage: It has considerable reserves of niobium to be used in the superconductor (possible component for the fusion nuclear reactor) and there is much world interest in that material, particularly by Japan. That certainly could make viable a cooperation between the two countries in the technological area, considering that Japan is among the most advanced centers in nuclear fusion research.

[illegible]

[illegible]

BRIEFS

COST OF SEAMLESS TUBING--Brasilia--Over the next 3 years, NUCLEBRAS [Brazilian Nuclear Corporations] will spend $50 million to manufacture seamless tubing for sheathing the pellets of enriched uranium that will be used in the nuclear fission process, according to a statement yesterday by Jose Diniz de Souza, chairman of ELETROMETAL Fine Steels, Incorporated, the firm responsible for producing the tubes. According to Jose Diniz, ELETROMETAL developed the technology for manufacturing the seamless tubes over the past 2 years and is now in a position to supply the demand from the nuclear sector both for strategic components and for reactive materials such as titanium, zircaloy, and hafnium. He said that the domestic production of those components by ELETROMETAL means that the government will not have to import technology and corresponds to the objectives for which ELETROMETAL was established in 1972: "to produce a number of strategic materials in Brazil. The strategy for achieving that objective was worked out in close cooperation with the Armed Forces, chiefly through the Aerospace Technology Center (CTA) and the Army Research and Development Institute." [Text] [Sao Paulo O ESTADO DE SAO PAULO in Portuguese 8 Jul 82 p 31] 11798

CAMPO DE ROMA RESEARCH CENTER--Cesar Cals, minister of mines and energy, said on Friday that before the end of this year, he is going to propose that the Federal Government establish the National Plasma Physics Center. In principle, it is to be set up in Campo de Roma in Rio de Janeiro, near Itaguai, where Brazilian scientists will conduct further research in the nuclear field. It will coordinate the studies currently being carried out by eight university groups in Rio de Janeiro, Sao Paulo, and Rio Grande do Sul and by the Aeronautics Institute in cooperation with the CNEN (National Nuclear Energy Commission). The minister, who was delivering a lecture at the War College, said that the center will be the means of preparing Brazil to enter the closed club of nations possessing nuclear fusion technology. "All the industrialized countries are exchanging information because they have not yet mastered the technology. On the day when they do master it, they will sell their research. That is why Brazil wants to join the club--to gain access to information and prepare our group." Concerning the Brazilian-German nuclear agreement, the minister explained that it talks about the construction of eight nuclear power plants but stipulates only that the first four will be built in partnership with the KWU. The other four will be the object of international bids. [Text] [Rio de Janeiro GAZETA MERCANTIL in Portuguese 3-5 Jul 82 p 10] 11798

CSO: 5100/2215

CHIEF OF STATE OPENS URANIUM PROCESSING PLANT

Libreville L'UNION in French 10 Jun 82 pp 1, 4

[Excerpts] Equipped with a pumping station built on the Likedi River to supply 600 m^3 of industrial water per hour, 3000 m^3 capacity receiving vats linked by metal pipes 4 m long and 350 cm in diameter, storage areas for 2,400 tons, grinding machines, a 1000 kW power partially self-controlled crushing machine, 24 m-diameter thickening apparatus, eight 90 m^3 vats for sulfuric acid treatment, three 70 m^2 band filters for the filtration stage, means for storing 6000 m^3 of uranium liquid, a solvent shop for concentrating and purifying and another one for precipitating by magnesium followed by drying in order to obtain magnesium uranate, COMUF's [Franceville Uranium Mining Company] new uranium processing plant was inaugurated yesterday at Mounana by El Hadj Omar Bongo, president of the republic, who had laid its first sone in May 1980.

With yesterday's opening (Wednesday, 9 June0 of the new uranium processing plant, COMUF reaches the culmination of an investment program announced at the time of its 20th anniversary in August 1975. This program included notably the opening and equipping of the underground factories completed since August 1979, the construction of the new sulfuric acid production facility put into service on 26 January 1982, and finally the assembly of a new uranium processing plant. These details were given out yesterday at Mounana by the second vice prime minister, the minister of mines and petroleum, for whom these achievements are the perfect expression of the climate of understanding and confidence existing between the government and the directors of COMUF.

Worth [illegible] billion CFA francs, this factory, thanks to which COMUF will from now on process 450 thousand tons of ore instead of 300 thousand and will produce 1,500 tons of uranium metal annually (our 8 June edition), will make this company an organization well-equipped, at least on the level of material means of production, to confront the risks and challenges of the future, according to Mr Mouvagha Tchioba.

This portion of the second vice prime minister's speech echoed an earlier statement made by COMUF's chief executive officer, Mr Maurice Delaunay, in which the latter described this modern, supercapacious factory as "a bet on the future made jointly by private investors and the public sector", allowing for a rational exploitation of known reserves.

According to Maurice Delaunay, this remarkable industrial facility was created at the moment when the price of uranium fell 43 percent, and the financial condition of COMUF was compromised by this drop in the selling price of uranium on the world market. It was therefore indispensable to secure bank financing and to appeal to the participation of the work force in a period of austerity; a work force which, according to Etienne Guy Mouvagha must become Gabonese (at least 50 percent of the training personnel) in terms of the professional qualifications and competence of those Gabonese employees chosen to replace expatriates, so that the Gabonese nationalization policy will not be a budget basement version.

The policy of Gabonese nationalization, described in detail by Mouvagha Tchioba as it concerns COMUF, also formed the essence of the brief statement by the president of the republic, who recalled the importance which the government and the Gabonese Democratic Party (PDG) attach to its application in all private and public companies. The chief of state continued his speech in the Bateka language, exhorting the people of Mounana to work even harder.

9939
CSO: 5100/5675

BRIEFS

DANISH, SWEDISH N-PLANT RISK COMMITTEE--Denmark and Sweden will each have three members on the committee which will be appointed to investigate the risks and consequences of a casualty in the Barseback nuclear power plant. The chairman will be appointed from another Nordic country. That is the result of the Danish-Swedish deliberations which were completed in Stockholm on Friday. Both delegations met on Thursday to deal with the demand from the Danish Minister of Environment Erik Holst for a committee. The committee will meet and prescribe increased safety measures at Barseback. It will also study how nuclear power plants are designed in other countries, and what measures are taken when they are located near other country's national borders or population centers. [Text] [Stockholm DAGENS NYHETER in Swedish 17 Jul 82 p 7] 9287

CSO: 5100/2218

FRANCE

STATUS, EFFICIENCY OF PRESSURIZED WATER REACTORS STUDIED

Paris REVUE GENERALE NUCLEAIRE in French Mar-Apr 82 pp 174-195

[Study by Jean Bernard, Helene Celier, Jean-Claude Le Ralle, Francoise Maubacq, and Francoise Ouvry of the Programs Department, Atomic Energy Commission]

[Excerpts] I As of 1 October 1981, there were 277 nuclear power plant units throughout the world, located in 23 countries. Their net electric power was 157 GW. The United States, with 77 units and 57.5 GW, heads the list, providing 37 percent of the total nuclear power.

France is in second place, with 30 units and 22 GW, providing 14 percent of the power supplied; it is followed by Japan with 25 units, 17 GW, and 11 percent. We should mention that in September 1981, Yugoslavia became a member of the nuclear club.

The percentages supplied by the European Community, the CEMA [Council for Economic Mutual Assistance] countries, and the rest of the world are 27 percent, 11 percent, and 25 percent, respectively.

II The Growth of the French Nuclear Power Plants; Status as of 1 October 1981

2.1. Evolution of the French Nuclear Power Plant Program

In 1970, France selected the PWR [Pressurized Water Reactor] process for its nuclear power plant program, and began a preliminary industrial series consisting of the six 900 MW units located at Fessenheim (two units) and at Bugey (four units).

This decision was further confirmed by the option taken by EDF [French Electric Power Company], in accordance with the goals set by the government, to select for the short and mid-term periods only standardized units of the PWR type developed by

Framatome under a Westinghouse license. This first program (CP-1) led to the industrial development of 18 900 MW units (at the Tricastin, Gravelines, Dampierre, and Le Blayais plants) to respond to the desire to achieve a certain degree of national independence, a desire that was stimulated by the first international oil crisis. A second program (CP-2) covered ten 900 MW units (at the Saint-Laurent, Chinon, and Cruas plants). This was begun while the first industrial series was being completed. A first group of eight 1300 MW units (Paluel, Saint-Alban, and Flamanville plants) was also begun, and the decision was made to start on the second group of eight 1300 MW units (Cattenom, Belleville, Nogent, Golfech, Penly, and Chooz power plants). [See reference 2 in the bibliography]. The growth of French nuclear power (in net GWe) over the course of the years is shown in figure 1b [not included].

2.2. The status of the French Power Plants as of October 1981

After the energy debate last fall, the French government decided to begin six nuclear units in 1982 and 1983. These units would include one 900 MW PWR reactor for Chinon B-4, and five 1300 MW PWR reactors at Cattenom-3, Chooz B-1, Golfech-1, Nogent-2, and Penly-1.

The status of the nuclear program in France in October 1981 appears as follows.

a. There were 30 nuclear power plants in operation in the French power system, making up a net power of 21.8 GW, distributed as follows:

   1. six UNGG [Graphite-Gas Nuclear Units]
   2. one heavy water-gas reactor
   3. one breeder reactor (Phenix)
   4. one 300 MW PWR reactor
   5. 21 900 MW PWR reactors

Of these 30 units, 25 are in industrial operation and produce a net power of 17.3 GW*.

b. 25 nuclear power plant units are under construction (this means that the order for the execution of the nuclear boiler has been given to the manufacturer, Framatome). These units represent a net power of 27.3 GW, and are distributed as follows:

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* As of 1 January 1982, 28 units were in industrial operation, providing a net power of 20.1 GW.

    1. 12 900-MW PWR reactors
    2. 12 1300-MW PWR reactors
    3. 1 breeder reactor (Super-Phenix)

c. There is one nuclear unit whose order of execution for the nuclear boiler was scheduled to be issued in December 1981* (Belleville-2). This is a 1300-MW PWR reactor, representing a net power of 1.3 GW.

d. Six units are scheduled to be started in 1982 and 1983. These units will provide a net power of 7.3 GW, distributed as follows:

    1. one 900-MW PWR reactor
    2. five 1300-MW PWR reactors

2.3. Start of France's 900-MW PWR Plants and Contribution of the Nuclear Power Plants to Electricity Production

A detailed account of the start of the 900-MW PWR plants has been given by EDF and Framatome [see references 3 and 4 in the bibliography].

The curve showing the rise in power of France's nuclear power plants (figure 1b) clearly illustrates the significant impact of the successive start of service of the preliminary series (the first unit was connected in April 1977) and of the industrial series (the first units of the CP-1 and CP-2 programs were connected in March 1980 and January 1981, respectively. The first unit of the 1300-MW PWR series is scheduled to start in 1983.

Figure 2 shows the evolution of the percentages of conventional thermal power, hydroelectric power, and nuclear thermal power in the production of electricity during 1980-1981. We should observe that nuclear power rose from 16.4 percent at the beginning of 1980 to 23.5 percent at the end of that year, and reached 37.7 percent in 1981. This indicates the value of France's nuclear power program for the generation of electricity and for our energy independence. Figure 3 summarizes the entire French situation as of 15 October 1981, along with the establishment of the various power plants on French territory.

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* The order of execution was actually given on the scheduled date.

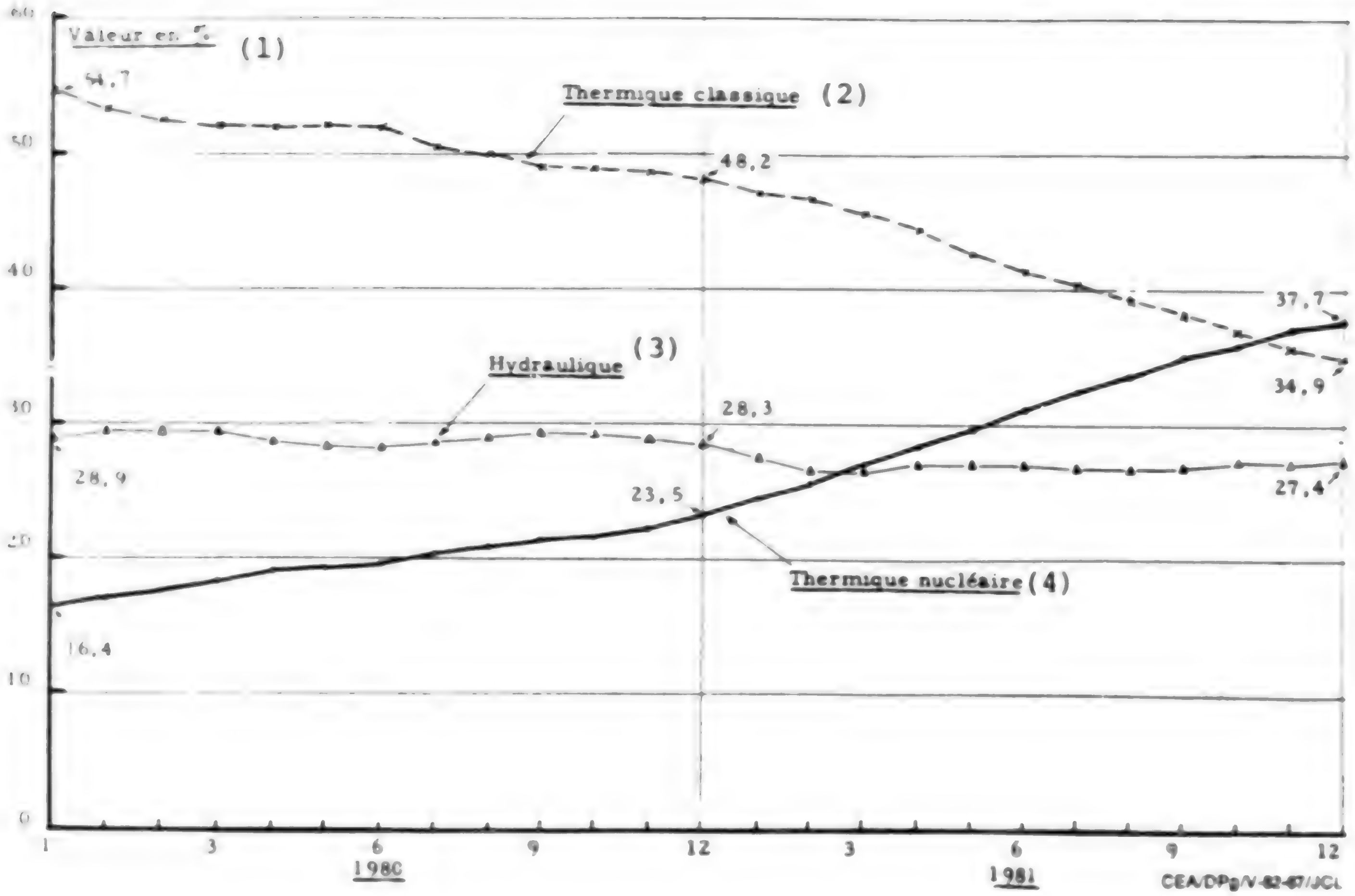

Figure 2: France: Evolution of the percentages of different sources in electricity production (based on 12 months, completed at the end of each month considered).

Key:

1. Value in percentage
2. Conventional thermal power
3. Hydroelectric power
4. Nuclear thermal power

III Statistical Analysis of Operation of the PWR Reactors in the World and in France as of 1 October 1981

As the ordinary water process is the essential component of the French nuclear power program, the CEA [Atomic Energy Commission] periodically conducts a statistical analysis of the operation [see references 5 and 6 in the bibliography] of this type of reactor, using data from the Elecnuc* data bank, which is designed to follow the operation of the nuclear power plants throughout the world and the changes in the international market for nuclear power units.

3.1. Parameters Considered

The coefficient of energy utilization, K, defined as the ratio between the electricity really produced by the facility and the energy it would have produced if it had operated without interruption during the entire period under consideration, at its nominal power, forms one of these parameters:

$$K = \frac{\text{gross electric energy produced}}{\text{gross nominal power of the facility} \times \text{duration of the period considered}}$$

This coefficient, K, may be expressed by a number (less than or equal to 1) or by a percentage. But the operation of a nuclear power unit can also be expressed in a different way, for example, by using the number of hours of operation equivalent to a continuous operation at full power (HEPP [Hours Equivalent at Full Power]), or sometimes even by using JEPP [Days Equivalent at Full Power], producing the same number of kWh, or quantity of electrical energy, as the real operation.

Based on the known and published values of the gross monthly electricity production, the elementary data available for nuclear power units in countries with a market economy all over the world, the operation of each unit may be characterized by K for different given periods. Then it is possible to make a statistical analysis of the operation of a set of n nuclear units, by calculating more closely the value of the arithmetic mean $\overline{K}$ of the units considered, the standard variation σ of the values of K in relation to $\overline{K}$, and the median value K_m which divides all the K values arranged in order of magnitude in two identical groups, possibly along with other parameters to try to refine the analysis.

The study covers the operation of PWR reactors of nuclear power plants for each 12-month period starting from a given date, the date of the first connection of each facility to the power system. By using this method, the behavior of the various sets of units can be examined during the initial phase of their operation in the electrical power system.

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* Sold on the European CISI [Expansion unknown] system.

In France, the MSI [Start of Industrial Service] takes place only after the level guaranteeing an operation at nominal power is achieved: unfortunately, that is not always the case in all other countries. In fact, the contractual or regulatory aspect of the conditions of start of industrial service (or start of commercial operation) differs from one country to the next, and sometimes from one unit to the next.

3.2. Description of the Global Sample and Results

The global sample includes all of the nuclear power units equipped with PWR reactors developed under license from manufacturers in market economy countries (Babcock and Wilcox, Combustion Engineering, and Westinghouse in the United States, and KWU-Siemens in the Federal Republic of Germany), whose gross electric power is superior or equal to 300 MW, and which had been in service for over 12 months by the date of 1 October 1981.

This sample is examined by making a classification into industrial generations of nuclear groups, using criteria based on the thermal power, the number of fuel assemblies, and the number of loops of the primary circuit.

3.3. Examination of Results

a) No matter what group is being considered in the global sample, there is some dispersion (values of σ) of the individual K coefficients. This dispersion is relatively significant and approximately equal to that found in the preceding studies, although the number of units included in the study has increased. It does appear, though, that when only the groups of the second industrial generation are considered (Table VIII), the Framatome units have standard variations that may be a little smaller, but because of the low values of n in the second and third, fourth and fifth periods, this conclusion can not be considered significant and definitive. Nonetheless, these results are satisfactory and encouraging for Framatome. Later studies made of larger groups will provide a better basis for comparison of the various manufacturers.

b) The arithmetic means $\overline{K}$ of the first period of operation differ significantly from those of the following periods. This can be explained perfectly by the variations in operation during the test period and the start of service. This result is valid no matter what group is being considered.

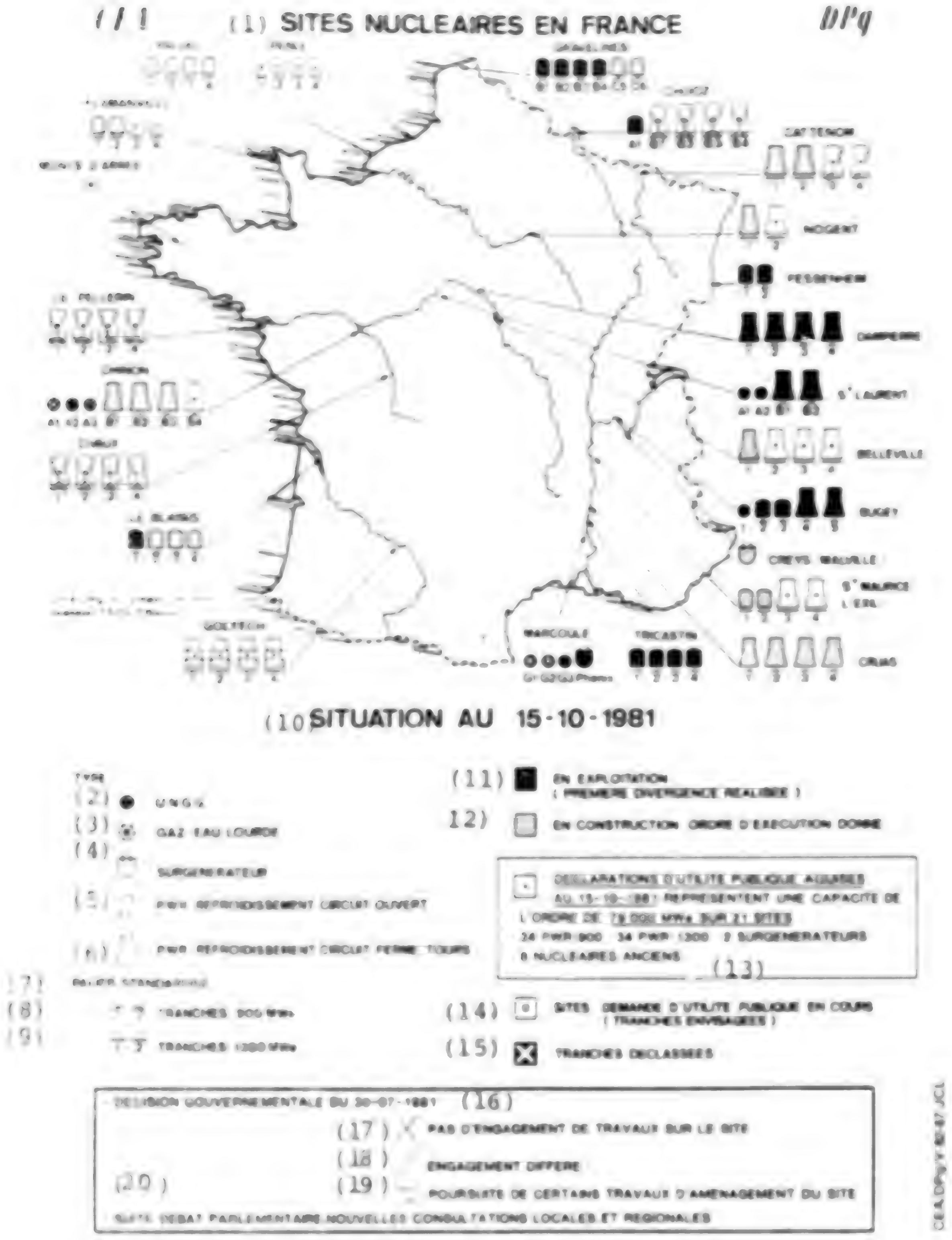

(1) SITES NUCLEAIRES EN FRANCE
PALUEL
PENLY
GRAVELINES
CHOOZ
FLAMANVILLE
MONTS D'ARREE
CATTENOM
NOGENT
FESSENHEIM
LE PELLERIN
DAMPIERRE
CHINON
S^T LAURENT
CIVAUX
BELLEVILLE
LE BLAYAIS
BUGEY
CREYS MALVILLE
S^T MAURICE L'EXIL
GOLFECH
MARCOULE
TRICASTIN
CRUAS
(10) SITUATION AU 15-10-1981
TYPE
(2) UNGG
(3) GAZ EAU LOURDE
(4) SURGENERATEUR
(5) PWR REFROIDISSEMENT CIRCUIT OUVERT
(6) PWR REFROIDISSEMENT CIRCUIT FERME TOURS
(7) PALIER STANDARDISE
(8) TRANCHES 900 MWe
(9) TRANCHES 1300 MWe
(11) EN EXPLOITATION (PREMIERE DIVERGENCE REALISEE)
12) EN CONSTRUCTION ORDRE D'EXECUTION DONNE
DECLARATIONS D'UTILITE PUBLIQUE ACQUISES AU 15-10-1981 REPRESENTENT UNE CAPACITE DE L'ORDRE DE 79 000 MWe SUR 21 SITES
24 PWR 900 34 PWR 1300 2 SURGENERATEURS
8 NUCLEAIRES ANCIENS
(13)
(14) SITES DEMANDE D'UTILITE PUBLIQUE EN COURS (TRANCHES ENVISAGEES)
(15) TRANCHES DECLASSEES
DECISION GOUVERNEMENTALE DU 30-07-1981 (16)
(17) PAS D'ENGAGEMENT DE TRAVAUX SUR LE SITE
(18) ENGAGEMENT DIFFERE
(19) POURSUITE DE CERTAINS TRAVAUX D'AMENAGEMENT DU SITE
(20)
SUITE DEBAT PARLEMENTAIRE NOUVELLES CONSULTATIONS LOCALES ET REGIONALES
CEA DPg

Figure 3: The French Nuclear Power Program as of 15 October 1981.

Key for Figure 3:

1. Nuclear sites in France
2. Graphite-gas nuclear unit
3. Gas-heavy water
4. Breeder
5. PWR-open circuit cooling
6. PWR-closed circuit cooling in towers
7. Standardized level
8. 900 MW units
9. 1300 MW units
10. Status as of 15 October 1981
11. Operating (has gone critical)
12. Under construction; order of execution given
13. Statement of public utility issued by 15 October 1981. Represents a capacity of about 79,000 MW on 21 sites. 34 900 MW PWR; 34 1300 MW PWR; two breeders; eight old nuclear units.
14. Sites: public utility applied for (work begun).
15. Units stopped
16. Government decision of 30 July 1981
17. No work started on site
18. Start of work delayed
19. Some site preparation work continued
20. After parliamentary debate, new local and regional meetings

c) For the first period, the values of the arithmetic means $\bar{K}$ decrease from the first generation to the second and to the third generations. For the other periods, only the values of the first generation are higher than those of the second and third generations, which do not differ much from each other.

For the relation between the factor of energy utilization K and the power P (increasing with the generation), a statistical examination of the results for the three generations of the first period would give a correlation coefficient ($r = -0.274$) and a regression line $K = 63.08-(2.02/100).P$ (figure 4) if in the first approximation all of the K values had a gaussian distribution. But an analysis of the distribution (figure 5a) shows that the distribution has a humped appearance and consequently, the preceding regression line is not necessarily valid. However, if this distribution is separated into two parts with a gaussian appearance corresponding to a first group of 29 units with a $\bar{K}$ equal to 25.1 percent and a second group of 52 units with a $\bar{K}$ equal to 58.3 percent, the search for a correlation between K and P will be negative for the correlation coefficients are too low ($r_1 = -0.101$ and $r_2 = -0.107$); thus the regression lines of each of these groups (see figure 4) are not significant. So it is difficult at this time to attempt to link the evolution of $\overline{K}$ to the power. In fact, this sample includes, in quantities varying according to the generations, units which are still the first of their series. In addition, a number of regulatory and behavioural constraints (in the United States, after the Three Mile Island accident) have limited the operation of some units, particularly the most recent, during their first periods of operation.

d) For the complete sample and the industrial generations, the mean values of $\overline{K}$ obtained on 1 October 1981 remain close to the value found in the preceding study, with the data available on 1 September 1980, which had shown a systematic decline in the values of $\overline{K}$ in relation to the studies done in early 1979 and during 1978.

This decline may be attributed to the TMI (Three Mile Island) accident and may be only temporary, as figure 5b would seem to suggest. The mean $\overline{K}$, which was about 70 percent for the period preceding TMI, after dropping to about 55 percent, has moved back up to 60 percent for the second 12-month period following the accident, for reactors all over the world.

e) The first generation is characterized by reaching a stable operating regime in three successive phases (first period, then second, third, followed by the fourth period and following periods). This result is comparable to that found in the preceding studies, using the international sample which consisted essentially of units of this first generation.

The mean values of $\overline{K}$ in the second and third generations are lower than those of the first generation, and therefore, the stable operating regime is reached more rapidly. This is certainly an effect of the constraints brought about by the TMI accident on the American reactors, whose weight in the global sample is quite significant.

f) In France, in order to draw up the reference operating hypotheses, the CCPEON [Advisory Commission for the Production of Electricity of Nuclear Origin] used the earlier studies prepared by the CEA for 1978 and 1979. In the international sample available for these studies, the weight of the first industrial generation was relatively large (35 percent and 32 percent). Because of its selection of having the operating regime reached in three phases, the CCPEON agreed that the evolution of operation of the first generation could be extended to the second

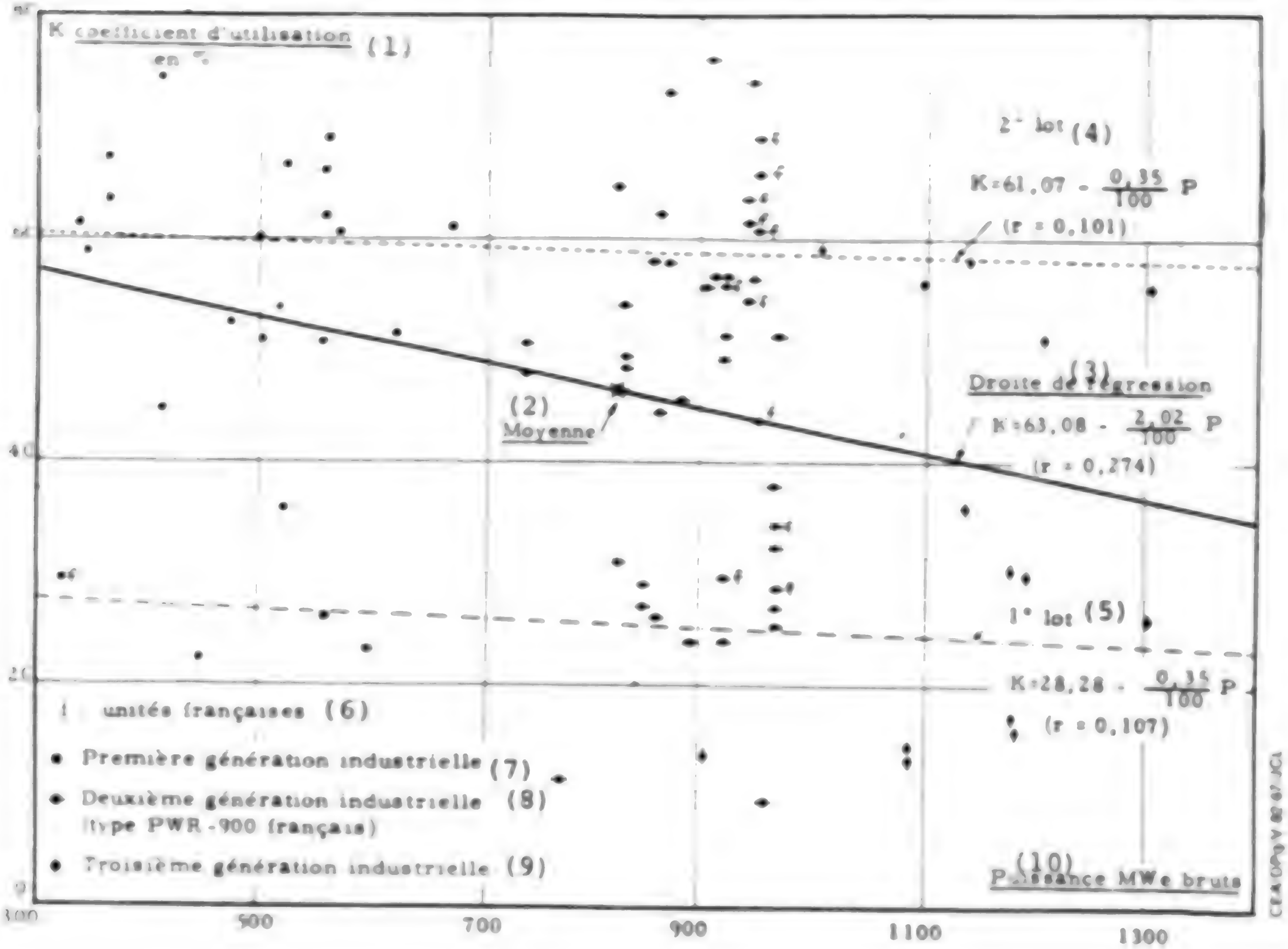


Figure 4: PWR process. Coefficient of energy utilization and gross electric power. First year of operation after connection to the system (81 units on 1 October 1981).

Key:
1. Utilization coefficient
2. Mean
3. Regression line
4. second group
5. first group
6. French units
7. First industrial generation
8. Second industrial generation (900 MW PWR French type)
9. Third industrial generation
10. Gross power in MW

and third industrial generations connected to the power system. During the second generation, with groups that were still quite small, the comparison between manufacturers was favorable to the French firm, Framatome. The results obtained do not indicate that the hypotheses used for reaching operating regime should be questioned in any way.

For the French group of 900 MW PWR reactors, the mean values of $\bar{F}$ obtained (table IX) are higher than or close to the values found in the 1978 and 1979 studies. But the numbers n are still too small in the latest periods for any definitive conclusions to be reached.

	French 900-MW PWR	Framatome	CEA Studies 1978-1979
first period	51.6%	52.0%	45.7%
second period	67.7%	64.2%	50.5%
third period	62.2%	65.7%	60.5%
fourth period	70.1%	74.4%	60.8%

These results place the French units in a very good position in terms of the rest of the world and seem to confirm the wisdom of this three-phase approach to reaching operating regime, at least for the time being.

The current expansion of the French PWR reactors (11 units in the sample on 1 October 1981, and another ten units in their first year of operation at that date), consisting of standardized units, should soon enable us to determine a mean annual utilization coefficient for the French system, which could include certain features particular to France's units, but still without ignoring the information that can be learned from a technically close international sample.

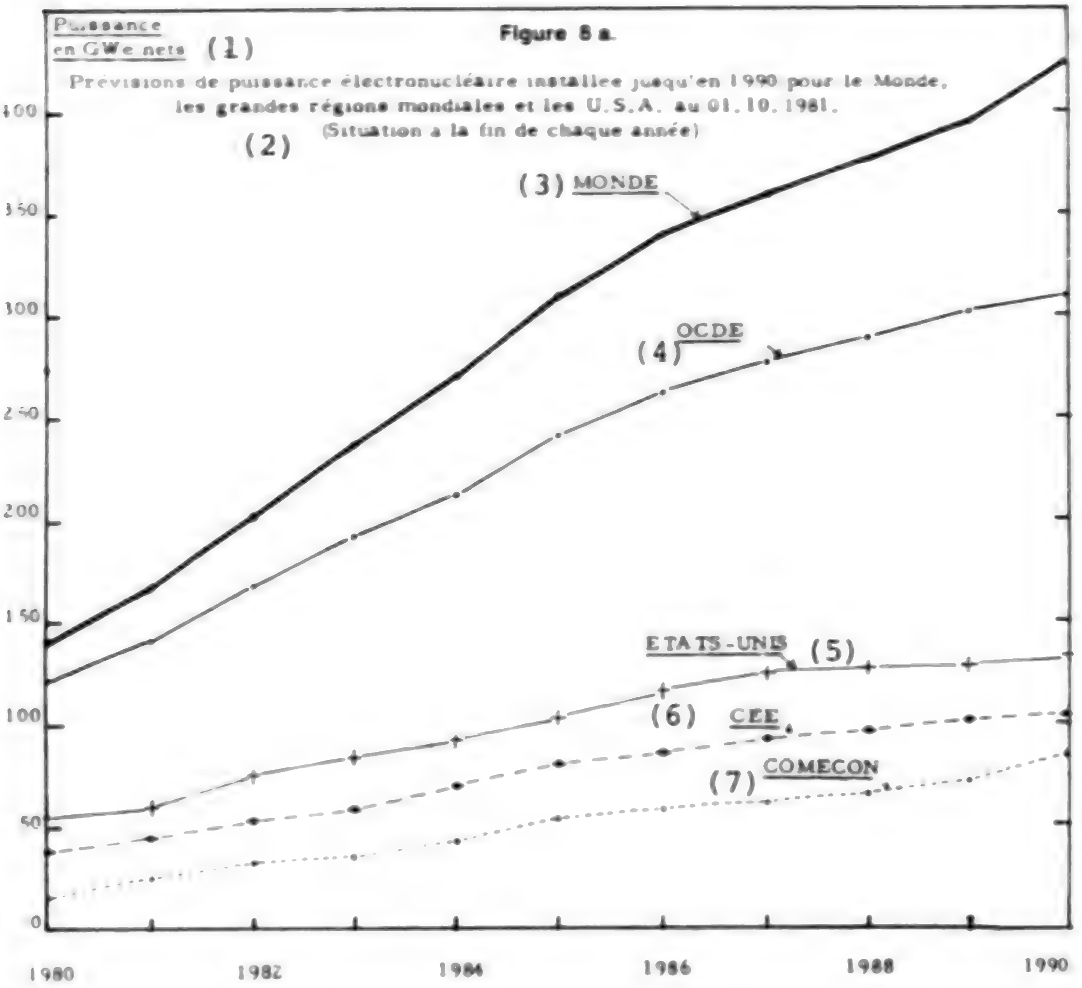
E) Construction Times for Nuclear Power Units Throughout the World

Study of France's Reactors

Table XI summarizes for France the durations 1, 2, 3, and 4 of the various phases of completion of 900 MW and 1300 MW PWR plants. Based on this table, it does appear that a very definite improvement (from 85 to 67 months on the average) came about from 1977 to 1981. This is also illustrated in figure 6 for the 900 MW PWR reactors (average duration D3). This improvement indicates a certain degree of mastery due to the effect of standardization

Figure 8 a.

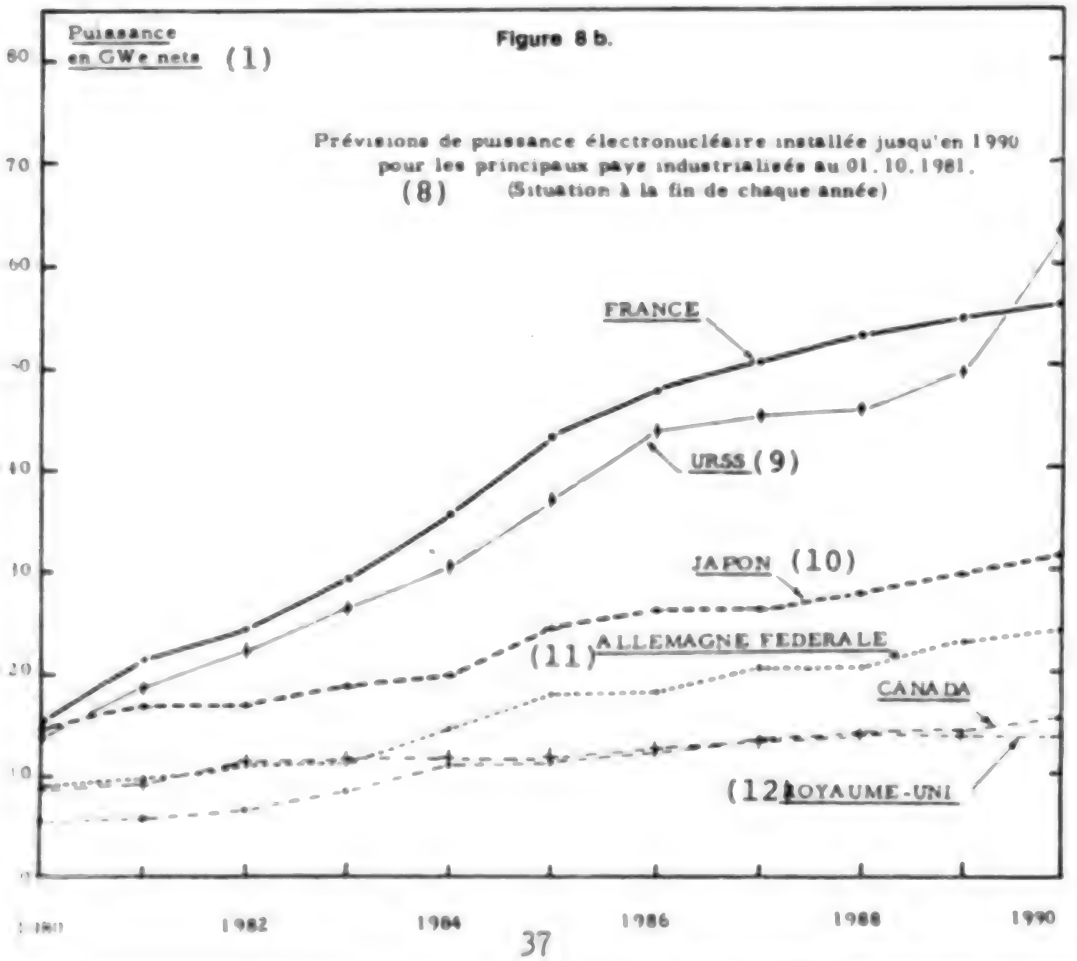
Prévisions de puissance électronucléaire installée jusqu'en 1990 pour le Monde, les grandes régions mondiales et les U.S.A. au 01.10.1981.
(Situation à la fin de chaque année)



CEA DPg/V-82-87 JCL

Figure 8 b.

Prévisions de puissance électronucléaire installée jusqu'en 1990 pour les principaux pays industrialisés au 01.10.1981.
(Situation à la fin de chaque année)



CEA DPg V-82-87 JCL

Key for Figures 8a and 8b:

1. Power in net GW
2. Forecasts for nuclear power until 1990 for the world, the major regions of the world, and the United States, as of 1 October 1981. (Status at the end of each year).
3. World
4. OECD [Organization for Economic Cooperation and Development]
5. United States
6. EEC [European Economic Community]
7. CEMA [Council for Economic Mutual Assistance]
8. Forecasts for nuclear power until 1990 for the major industrialized countries, as of 1 October 1981. (Status at the end of each year).
9. USSR
10. Japan
11. Federal Republic of Germany
12. United Kingdom

(the standard level concept), and the effect of the centralization of preparation and execution, along with the experience acquired. The duration of construction is gradually tending to reach the value of 60 months, which is an industrial performance of some interest when we refer to foreign construction periods (figure 6). The record of construction and start of service of the 900 MW units has been given in detail by EDF [see reference 2 in the bibliography]. It is still too early to express an opinion about the duration of construction of the 1300 MW PWR plants.

V Forecasts for the Worldwide and French Power Plant Programs

Short-term Forecasts (approximately a decade)

These forecasts may be made in a relatively precise manner, based on the status of projects now under construction, and on the projects on order or about to be ordered.

Figures 8a and 8b show the evolution of net installed powers predicted from 1980 to 1990. These predictions are based on the Elecnuc data bank which follows projects now under construction or on order. Figure 8a covers the world, the OECD, the EEC, the CEMA, the United States, while figure 8b covers the Federal Republic of Germany, Canada, France, Japan, the United Kingdom, and the USSR. Figures 8a and 8b meet figures 1a and 1b, which gave the past evolution of the various nuclear programs, at the year 1980.

Table V: Breakdown by manufacturer of the nuclear boiler (or nuclear component) of the units installed as of 1 October 1981 throughout the world, for the major nuclear processes used.

(1) **Filière (GWe nets) (Nbre d'unités)**	(2) **Constructeur**	(3) **(Pays)**	(4) **Puissance installée en GWe nets**	(5) **Nombre d'unités**	(6) **Nombre de pays**	(7) **Licence d'origine**
(8) PWR (87,5 GWe) (123 unités)	Westinghouse	(Etats-Unis) (17)	33,1	46	9	Westinghouse
	Framatome	(France)	20,1	23	2	Westinghouse
	Union Soviétique (13)		9,0	22	5	Union Soviétique
	Babcock et Wilcox	(Etats-Unis)	7,9	9	1	Babcock et Wilcox
	K.W.U.	(RFA) (18)	6,7	8	3	K.W.U. - Siemens
	Combustion Engineering	(Etats-Unis)	6,5	8	1	Combustion Engineering
	Mitsubishi	(Japon) (19)	4,2	7	1	Westinghouse
(9) BWR (40,4 GWe) (63 unités)	General Electric	(Etats-Unis)	26,8	42	9	General Electric
	ASEA-Atom	(Suède) (20)	6,0	9	2	ASEA-Atom
	K.W.U.	(RFA)	3,1	4	1	General Electric
	Toshiba	(Japon)	3,1	4	1	General Electric
	Hitachi	(Japon)	1,2	2	1	General Electric
	Allis Chalmers	(Etats-Unis)	0,06	1	1	Allis Chalmers
	Union Soviétique		0,06	1	1	Union Soviétique
(10) PHWR (6,2 GWe) (15 unités)	A.E.C.L.	(Canada)	5,8	13	3	A.E.C.L.
	K.W.U. - Siemens	(RFA)	0,4	2	2	Siemens
(11) Graphite-gaz (11,5 GWe) (40 unités)	Constructeurs U.K. (14) (AGR et Magnox)	(Royaume-Uni) (21)	8,8	33	3	Constructeurs U.K.
	Constructeurs français (UNGG) (15)	(France)	2,7	7	2	Constructeurs français
(12) RBMK (9,3 GWe) (22 unités)	Constructeurs soviétiques (16)		8,5	21	1	Constructeurs soviétiques
	Burns et Roe-Kaiser Engineers	(Etats-Unis)	0,8	1	1	U.S.A.E.C

Key:

1. Process (net GWe) (Number of units)
2. Manufacturer
3. Country
4. Installed power in net GWe
5. Number of units
6. Number of countries
7. Original license
8. PWR (87.5 GW) (123 units)
9. BWR [Boiling Water Reactor] (40.4 GW) (63 units)
10. PHWR (6.2 GW) (15 units)
11. Graphite-gas (11.5 GW) (40 units)
12. RBMK (9.3 GW) (22 units)
13. Soviet Union

14. UK manufacturers (AGR and Magnox)
15. French manufacturers (UNGG)
16. Soviet manufacturers
17. United States
18. Federal Republic of Germany
19. Japan
20. Sweden
21. United Kingdom

Note: The values are rounded off. The value of the sum may be different from the sum of the values rounded off.

Table XII provides a basis for a comparison between different forecasts of installed power in 1990, determined either from figures 8a and 8b, or from data from government organizations. These estimates (the second column of figures) are generally higher than the data from the Elecnuc data bank, which cover only projects which have reached at least the stage of being ordered. In the third column of table XII are given CEA/DPg [programs department] estimates, made as part of a longer term projection (up to 2000), based on official government forecasts and also on the known or foreseeable possibilities of development in the various countries concerned.

VI General Conclusion

At the end of 1981, France was in second place in the world, behind the United States, with a total installed power of 22 GWe.

The completion of the first phase of the nuclear program, which began in 1970, has made this position possible, and has helped to make France more energy-independent. This first phase was completed without any excessive delays.

The statistical analysis done for all of the PWR reactors now in operation has shown satisfactory and encouraging results for the French manufacturer, Framatome. The French units of the 900 MW level will in the near future provide a homogenous group which can be analyzed independently, from the point of view of operation. This will not mean, however, that the technically close reactors in the rest of the world will be ignored. A comparison with the hypotheses selected by the CCPEON may be made.

The current construction times further reveal the good position of France and the positive effect of the standardization of the CP-1 and CP-2 programs.

Table VIII: Values of $\bar{K}$ and σ, by manufacturer, for the second industrial generation, expressed in percentages.

Constructeurs (1)		(3) Périodes de 12 mois					(4) Regroupement à partir de la		
		1re	2e	3e	4e	5e	2e	4e	
Westinghouse et ses licenciés autres que Framatome (2)	n	14	12	12	11	10	70	46	**Puissance (5) brute moyenne : 844,1 MWe** Age maximum (6) ... 11.0 ans Age moyen ... (7) ...... : 6.3 ans Expérience sur réseau (8) 88.0 ans Nombre de pays (9) 3
	$\bar{K}$	45.4	56.7	58.2	49.2	52.9	54.5	52.9	
	σ	18.2	11	14.3	24	21.7	18.4	20.9	
	K_m (*)	48.6	55.8	58.7	60.8	56.5	57.7	57.7	
Framatome	n	12	7	5	3	1	17	5	**Puissance brute moyenne : 943 MWe** Age maximum .... : 6.6 ans Age moyen ... 2.7 ans Expérience sur réseau .. : 32.8 ans Nombre de pays .... : 2
	$\bar{K}$	52.0	64.2	65.7	74.4	78.3	68.2	76.3	
	σ	14.3	10.9	12.3	9.6	—	11.2	7.4	
	K_m	56.7	66.0	66.3	76.2	—	66.3	78.3	
Babcock et Wilcox	n	9	9	9	8	6	45	27	**Puissance brute moyenne : 919,1 MWe** Age maximum .... : 8.4 ans Age moyen .... : 6.3 ans Expérience sur réseau 56.8 ans Nombre de pays .... : 1
	$\bar{K}$	43.8	40.8	55.3	58.2	61.9	52.2	54.9	
	σ	17.3	18.3	23.8	13.4	4	21	18.5	
	K_m	45.5	39.8	63.4	59.8	62.5	57.9	58.5	
Combustion Engineering	n	9	9	9	8	6	45	27	**Puissance brute moyenne : 883,8 MWe** Age maximum ... 9.8 ans Age moyen ... 6.3 ans Expérience sur réseau .. : 44.2 ans Nombre de pays 1
	$\bar{K}$	42.5	64.4	54.9	68.4	62.6	62.8	64.5	
	σ	22.6	15.8	27.6	16.7	17.5	18.5	18.7	
	K_m	44.3	65.9	63.9	68.1	55.4	64.8	65.4	
KWU	n	2	2	1	1	1	5	2	**Puissance brute moyenne : 912,5 MWe** Age maximum 5.3 ans Age moyen .... 4.0 ans Expérience sur réseau . 8.0 ans Nombre de pays 2
	$\bar{K}$	59.6	69.6	76.0	49.5	80.0	68.9	64.7	
	σ	11.7	6.4	—	—	—	12.1	21.5	
	K_m	59.6	69.6	—	—	—	74.1	64.7	

(*) Valeur médiane qui partage l'ensemble des valeurs K rangées par ordre de grandeur en deux lots identiques en nombre. (10)

Key:

1. Manufacturers
2. Westinghouse and its licensees other than Framatome
3. 12-month periods
4. Regrouping after the: 2nd; 4th
5. Gross average power
6. Maximum age
7. Average age
8. Experience on the power network
9. Number of countries

10. K_m = median value which divides all the values of K arranged in order of magnitude into two groups identical in number.

Based on the forecasts as of 1 October 1981, by 1990 France should be in competition with the Soviet Union for second place in the world, behind the United States, and preceding Japan and the Federal Republic of Germany.

(1) **Tranches PWR 900 françaises ayant plus d'un an d'exploitation sur le réseau**

Nom des tranches (2)	(6) Première période	(7) Deuxième période	(8) Troisième période	(9) Quatrième période	(10) K cumulé au octobre 1981	(11) Age en années
Fessenheim 1	29.8	76.3	66.3	64.0	58.8	4.5
Fessenheim 2	56.8	61.0	75.8	76.2	67.5	4.0
Bugey 2	28.5	65.0	56.0	—	47.4	3.4
Bugey 3	34.1	75.0	50.8	—	54.8	3.0
Bugey 4	63.4	65.0	—	—	69.4	2.6
Bugey 5	61.4	63.7	—	—	63.8	2.2
Gravelines B-1	43.2	—	—	—	57.1	1.6
Dampierre 1	54.7	—	—	—	56.5	1.5
Tricastin 1	60.9	—	—	—	62.7	1.3
Tricastin 2	65.7	—	—	—	66.9	1.1
Gravelines B-2	68.6	—	—	—	63.6	1.1
Regroupement (3)	Première période	Deuxième période	Troisième période	Quatrième période	(12) Valeurs regroupées à partir de la deuxième année	
Nombre de tranches	11	6	4	2	12	
$\overline{K}$ (4)	51.6	67.7	62.2	70.1	66.3	
Ecart type σ (5)	15.0	6.4	11.1	8.7	8.3	
K_m (*)	56.8	65.0	61.1	70.1	65	

L'expérience cumulée sur le réseau des unités ayant plus d'un an au 01-10-1981 est de : 28.2 ans. (13)

(*) K_m = Valeur médiane qui partage l'ensemble des valeurs K rangées par ordre de grandeur en deux lots identiques en nombre. (14)

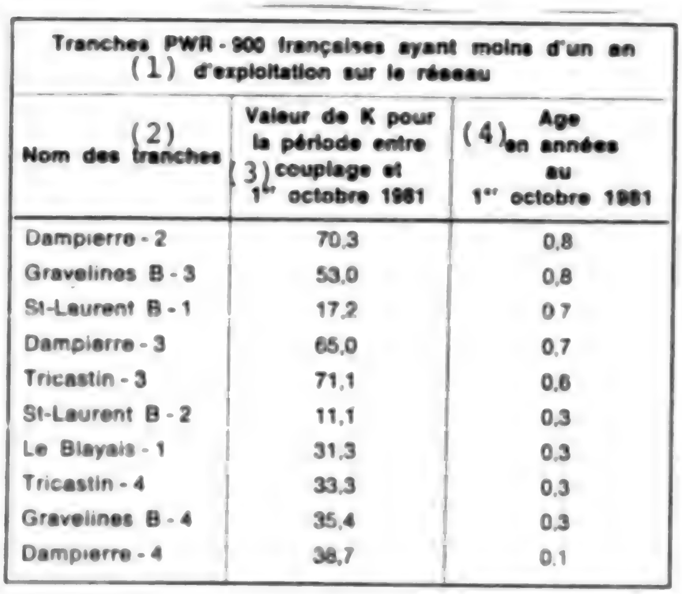
Table IX: French 900 MW PWR Reactors in operation for over 1 year. Values (in %) of K and K accumulated for each unit. Values (in %) of $\overline{K}$, and K_m for the entire group of reactors, by period.

Key:

1. French 900 MW PWR units in operation for over 1 year.
2. Name of units
3. Grouping
4. Number of units
5. Standard variation σ

6. First period
7. Second period
8. Third period
9. Fourth period
10. K accumulated as of 1 October 1981
11. Age in years
12. Values grouped starting with the second year
13. The cumulative experience in the power system of units in operation for over 1 year as of 1 October 1981 is 26.2 years.
14. K_m = median value which divides all the values of K arranged in order of magnitude into two groups identical in number.

Table X: Values of K (in %) and Ages of the French 900 MW PWR Units in Operation for less than 1 Year



Tranches PWR - 900 françaises ayant moins d'un an (1) d'exploitation sur le réseau		
(2) Nom des tranches	**(3) Valeur de K pour la période entre couplage et 1er octobre 1981**	**(4) Age en années au 1er octobre 1981**
Dampierre - 2	70,3	0,8
Gravelines B - 3	53,0	0,8
St-Laurent B - 1	17,2	0,7
Dampierre - 3	65,0	0,7
Tricastin - 3	71,1	0,6
St-Laurent B - 2	11,1	0,3
Le Blayais - 1	31,3	0,3
Tricastin - 4	33,3	0,3
Gravelines B - 4	35,4	0,3
Dampierre - 4	38,7	0,1

Key:

1. French 900 MW PWR units in operation for under 1 year
2. Name of units
3. Value of K for the period between connection and 1 October 1981
4. Age in years on 1 October 1981

Table XI: Construction Time for French PWR Units (in months)

Nom de la centrale (1)	Filière (2)	Durée 1 (3)	Durée 2 (4)	Durée 3 (5)	Durée 4 (6)	
FESSENHEIM 1	FR/PWR	2	77.14	85.94	87.95	
FESSENHEIM 2	FR/PWR	0	71.19	76.51	76.51	
BUGEY 2	FR/PWR	13.56	69.65	74.41	87.98	
BUGEY 3	FR/PWR	1.54	77.27	86.63	88,18	Bugey 2 et 3
BUGEY 4	FR/PWR	0	66.06	69.38	69.38	
BUGEY 5	FR/PWR	3.94	62.98	68.1	72.04	
DAMPIERRE 1	FR/PWR	4.89	66.69	72.31	77.2	
GRAVELINES B - 1	FR/PWR	1.87	69.38	77.83	79.7	
TRICASTIN 1	FR/PWR	0	73.85	79.93	79.93	
TRICASTIN 2	FR/PWR	7.88	68.2	72.04	79.93	
GRAVELINES B - 2	FR/PWR	9.92	66.75	70.07	80	
DAMPIERRE 2	FR/PWR	12.84	67.35	69.58	82.43	
TRICASTIN 3	FR/PWR	14.85	67.38	70.37	85.22	
DAMPIERRE 3	FR/PWR	18.89	62.98	66.82	85.71	
GRAVELINES B - 3	FR/PWR	16.88	63.37	68.99	85.88	
GRAVELINES B - 4	FR/PWR	0	58.41	61.99	61.99	
LE BLAYAIS 1	FR/PWR	25.88	60.35	64	89.88	(7) 12 commandes fermes C.P. 1 - 900
TRICASTIN 4	FR/PWR	19.87	66.36	70.01	89.88	
SAINT LAURENT B - 1	FR/PWR	22.86	58.71	68.04	90,9	
SAINT LAURENT B - 2	FR/PWR	0	53.97	59.99	59.99	
DAMPIERRE 4	FR/PWR	0	58.54	64.95	64.95	
LE BLAYAIS 2	FR/PWR	0	64.95	68.96	68.96	
CHINON B - 1	FR/PWR	15.4	64	69.02	84.43	
CHINON B - 2	FR/PWR	18.39	65.01	68.99	87.39	
LE BLAYAIS 3	FR/PWR	23.42	62.02	65.97	89.39	(8) 4 commandes fermes C.P. 2 - 900
LE BLAYAIS 4	FR/PWR	25.46	63.93	67.94	93,4	
CRUAS 1	FR/PWR	0	63.01	68	68	
PALUEL 1	FR/PWR	18.39	74.02	81.01	99.41	
CRUAS 2	FR/PWR	0	62.02	66	66	
PALUEL 2	FR/PWR	22.43	76.97	82	104.44	
CRUAS 3	FR/PWR	0	60.02	64.03	64.03	
PALUEL 3	FR/PWR	31.4	74.02	78.98	110.39	(8)
CRUAS 4	FR/PWR	0	60.02	64	64	
GRAVELINES C - 5	FR/PWR	0	60.56	64.52	64.52	4 commandes fermes C.P. 1 - 1300
SAINT MAURICE 1	FR/PWR	40.37	70.31	76.05	116.42	
FLAMANVILLE 1	FR/PWR	0	72.01	78.06	78.06	
GRAVELINES C - 6	FR/PWR	0	59.59	64	64	
PALUEL 4	FR/PWR	0	69.02	73	73	
SAINT MAURICE 2	FR/PWR	0	68	71.98	71.98	
CATTENOM 1	FR/PWR	7.76	71.55	77.53	69.78	
FLAMANVILLE 2	FR/PWR	0	68.96	72.96	72.96	
CATTENOM 2	FR/PWR	0.82	68.96	72.96	73.79	
CHINON B - 3	FR/PWR	5.51	52.99	64	69.51	
BELLEVILLE 1	FR/PWR	5.84	67.94	73.92	79.77	

Key for Table XI:

1. Name of plant
2. Process
3. Duration 1
4. Duration 2
5. Duration 3
6. Duration 4
7. 12 firm orders
8. Four firm orders

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SWEDEN

FIRST REPORT ON COST OF HANDLING SPENT NUCLEAR FUEL ISSUED

Stockholm DAGENS NYHETER in Swedish 2 Jul 82 p 22

[Article by Ingvar Andersson]

[Text] The total cost of handling waste from the Swedish nuclear power program will be 32 billion kronor.

This was the estimate of the Swedish nuclear power industry, as announced by its organization the Swedish Nuclear Fuel Supply Company (SKBF) in a report presented to the State Board for Nuclear Fuel Disposal (NAK).

This cost includes the total waste-disposal program--transport, final storage, and dismantling of nuclear power plants.

The cost is calculated in terms of 1981 monetary value and corresponds to 10 percent of the revenues from nuclear power plants.

The nuclear power industry estimates that the last waste canister will be buried around the year 2060.

The money is being generated through a special fee--presently 1.7 ore per kilowatt-hour--on the price of energy. The money is kept in funds by the nuclear power companies. Since 1976 when money for waste disposal first was set aside in the funds, a total of 2 billion kronor has been collected.

Director general Gerhard Rundquist of the State Board for Nuclear Fuel Disposal (NAK), which is the Industry Department's organ for such issues, told DAGENS NYHETER he believed that the nuclear power industry's calculations were correct:

"The nuclear power industry has made a thorough and detailed study of all conceivable costs," Rundquist said.

No Details

"With regard to the repositories, transports, and plant dismantling we can estimate the costs quite well and I have no doubt that the figures are correct," Rundquist said.

"There is some uncertainty, however, when it comes to the future operating costs. It is difficult to calculate what it will cost to operate waste facilities for 40 to 50 years through the 2060's when the site will be abandoned."

"During that time no new revenues will be generated if needed. There will be only expenditures."

The report from the nuclear power industry may be seen as the first thorough survey of nuclear waste disposal.

It "contains everything" according to the Industry Ministry--the quantity of waste, the number of ship transports, timetables for dismantling nuclear power plants, plans for various storage sites, etc.

Still, it is not a detailed report: On the contraversial topic of where the final storage will be located the report indicates "a site 600 km north of Stockholm and 150 km from the coast."

Wilhelmina?

If circles are drawn according to these instructions they intersect around Wilhelmina, but the nuclear power industry stated that this merely was an example upon which to base economic calculations.

During the remaining years of the 1980's, 10 to 20 rock formations will be examined and their crack formations studied. During the nineties, some of these sites will be studied in detail and early in the year 2000 construction on the site will begin.

In addition to the main requirement of structural integrity, the site must be within reasonable distance of a harbor and either be located near a railroad line or be on a site suitable for construction of a railroad.

The report to the Industry Minister also contains a survey of recent research on nuclear waste.

This survey indicates that the nuclear power industry is examining the possibility of using plutonium as a fuel in Swedish reactors. If this fuel is used, Sweden would have access to relatively large quantities of plutonium. Plutonium can be mixed with uranium to form so-called MOX (mixed oxide) fuel. For some time experiments with this fuel have been underway at the Oskarshamn I nuclear reactor. The nuclear power companies believe that it will be possible to use the plutonium fuel mixture in Swedish reactors during the late eighties.

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SWEDEN

BRIEFS

NUCLEAR-PLANT DISASTER PLAN LACKING--"At present we have no viable emergency plan for a possible accident at a nuclear power plant, even though it has been 10 years since the first nuclear power unit went into operation. The state must improve preparedness for accidents at nuclear power plants as soon as possible." This was written by the local safety board at the Ringhals nuclear power plant in a letter to the government. "The division of responsibility for rescue work following an accident at a nuclear power plant has not been established," said Allan Hyden, chairman of the safety board. The roles of the police and the provincial government also remain unclear. "The present system with officers on duty at the provincial government offices is unsatisfactory. Instead, emergency preparedness should be maintained by the officer on duty at the Varberg Police Department." Allan Hyden also pointed out that doctors doubt that the iodine tablets distributed to people living near Ringhals would be of any value following an accident at a nuclear power plant. Recently the siren at Ringhals has sounded several false alarms which, according to the safety board, has undermined public confidence in the alarm. "It also is remarkable that the planned training of personnel in the vicinity of the power plant has been postponed because the state and the local authorities cannot agree on who should pay for the training," Allan Hyden said. [Text] [Stockholm DAGENS NYHETER in Swedish 2 Jul 82 p 22] 9336

CONCERN OVER N-PLANT SAFETY--All nuclear power plants in Sweden lack special medical preparedness measures for those living nearby. Despite frequent careful readiness plans there is no organization for medical personnel to provide assistance at assembly places in the event of a nuclear power accident. Several doctors in Varberg are now reacting against this, and want a plan set up for the Ringhals nuclear power plant. "As the person directly responsible for medical preparedness in northern Halland it is my duty to inform the politicians about the poor situation which exists for the 7,000 who live within 10 km of Ringhals," said Professor Herbert Sunzel in Varberg. Next month, therefore, medical personnel, county councillors and administrators will meet in Varberg to lay the foundation for a program for medical preparedness for a possible accident at Ringhals. The medical resources existing today are limited to the personnel at Ringhals, and this applies also to the other three nuclear power plants in Sweden. [Text] [Stockholm SVENSKA DAGBLADET in Swedish 17 Jul 82 p 7] 9287

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